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Kay Nelson
The University of Kansas

Rajendra Srivastava
The University of Kansas

Alexander Kogan
Rutgers University

Miklos Vasarhelyi
Rutgers University

Inquiring Information Systems in the Boundary-Less World: The FRAANK Example

Kay M. Nelson (knelson@ukans.edu), Rajendra P. Srivastava (rajendra@falcon.cc.ukans.edu), The University of Kansas, Alexander Kogan (kogan@rutcor.rutgers.edu), Miklos A. Vasarhelyi, (miklosv@andromeda.rutgers.edu), Rutgers University

Introduction

The boundary-less world has increased the number of "wicked" problems facing managers today. The Internet has created a potentially open electronic world at the same time that organizations are tying themselves to proprietary enterprise system infrastructures. The basic concepts of doing business electronically have not been worked out. The security infrastructure underlying the foundations of electronic commerce is in its infancy, and the issues of confidentiality, authentication, data integrity, and non-repudiation remain barriers to truly removing boundaries between enterprises (Bhimani 1996). The five types of evidence generating information systems laid out by Mason and Mitroff (1973); Lockean, Leibnizian. Kantian, Hegelian, and Singer - Churchmanian, are discussed here in the context of internet agents. The convergence of these perspectives is then demonstrated in the architecture of the FRAANK (Financial Reporting Auditing Agent with Net Knowledge) intelligent agent (Kogan et. al, 1998).

Lockean IS: A Lockean IS is characterized by a need for consensus in the system. A Lockean information system can also be seen as "a filing system that can grow its own categories (Churchman, 1971)," i.e.: the Internet. The problem, according to Churchman, is that the system needs to be usable. Search engines attempt this, but often return conflicting or disparate results (Horwitt, 1997). Intelligent agents working on behalf of accounting firms need to utilize the Internet to retrieve information while at the same time making sense of what is encountered. While traditional accounting systems have primarily reflected the Lockean approach, intelligent agents need to combine the Lockean task of ordering information and consensus with other approaches to sorting out the large amount of disparate information on the web.

Leibnizian IS: A Leibnizian IS is a closed system with elementary embedded axioms. Rule-based expert systems are an example of Leibnizian IS (Courtney et al., 1998). The biggest drawback to Leibnizian IS may be its assumption of a single "best" answer or model (Mason and Mitroff, 1973). If information is defined as knowledge for the purpose of taking effective action, and knowledge is defined as the capture of experience, context, interpretation, and reflection of action (Davenport et. al 1998), how do Leibnizian IS deal with context? Madnick (1997) describes three types of context: geographical, functional, and organizational. Geographical context is also a type of cultural context, in that the ways things are interpreted in the US may be different from that in other countries. Functional context differences can exist within the same organization and location when different functional areas interpret and use information differently. With organizational context, the information used in the same function, in the same industry, in the same country, can have different meanings between two or more companies. Madnick (1997) uses the example of credit ratings. CitiBank might define a credit rating differently from the way Chase does. Leibnizian IS have a difficult time interpreting these contextual differences. One question that arises, from both a practical and research perspective, relates to purchased software packages and vendor supplied enterprise systems. Do these systems reflect a Leibnizian perspective, and if they do, what embedded axioms within them does an organization have to understand and deal with? Are these systems truly capable of capturing context, and if so, from what philosophical perspective do they do so? What is the impact of these imbedded axioms and philosophies on the boundary-less world?

In the domain of accounting and accounting services on the Internet, context becomes a "wicked" problem. An intelligent agent programmer building an agent to draw conclusions about the financial position of a company based on non-financial information will first have to program the agent to extract the information from the web site. Once the intelligent agent extracts the information from a web site, the context of the information is lost, making it difficult for a computer program, let alone a human, to understand the intended meaning of the information. In effect, the Leibnizian nature of the information is lost. Therefore, the ability to distinguish context as part of the search activity becomes a key attribute of agents like FRAANK.

Kantian IS: Mason and Mitroff describe Kantian IS as multi-model synthetic systems. These systems chose among alternative a priori models. To do this, Kantian IS constantly scan internal and external environments for purposeful knowledge (Courtney et al., 1998). The Kantian perspective acknowledges that inputs received from various knowledge sources may have different interpretations. This makes these systems potentially useful for addressing accounting context problems. One way that agents can assess and distinguish context is through the inclusion of multiple logical processors within the agent intelligence. The inclusion of, for example, both rule based and uncertain reasoning would give the agent multiple ways to test context.

Hegelian IS: Hegelian IS are based on contradictory or conflicting views (Churchman, 1971). Many examples of Hegelian IS have been implemented in the past twenty five years (Courtney et al., 1998). Internet search engines are an example of Leibnizian IS that could benefit from a Hegelian approach. The closest things to Hegelian search currently found on the Internet are engines such as MetaCrawler (Etzoni and Selberg, 1997) that search many search engines. An ideal Hegelian accounting intelligent agent would only search from the users unique point of view, which could change and be contradictory as time passes. For example, the value of financial and non-financial information found on the web changes with time and with who is looking at the information. From whose point of view do we represent this information? How do we choose between contradictory information within industries of firms? The ability of accounting firms to answer these questions and anticipate the view of competitive information that will be of value to their clients will determine whether investments in agents like FRAANK will make money and provide value added services.

Singerian - Churchmanian IS: A Singerian - Churchmanian IS represents continual learning and adaptation through feedback (Mason and Mitroff, 1973). This is done through the transformation of "wicked" into structured problems and vice versa. Mason and Mitroff point out that an organization's structure and its systems are, in reality, two sides of the same coin. This is even more true twenty-five years later. Organizations are tied more closely to the system infrastructure than ever before**.** They are also tied to the infrastructure of customers, suppliers, and business partners. Through their choice of platforms, operating systems, and applications, organizations are also tied to their technology venders. Once again, the issue of boundary spanning with conflicting standards arises. With organizations constrained by these boundaries, the opportunity arises for accounting firms to unleash intelligent agents across industries to structure distributed and non-standardized information into meaningful business knowledge. While any service provider could potentially do this activity, the audit branches of large accounting firms are in a unique position to exploit this opportunity. The long term relationships these firms have developed with clients, as well as the number of clients and industries served, give them a unique combination of trust and insight to build on.

Intelligent Agents as an Example of the Convergence of Types of Evidence Generation: Internet intelligent agents have the potential to combine multiple philosophical perspectives. Intelligent agents are actually similar to Spinoza's concept of a free executive that searches intelligent space, finds knowledge, and adapts accordingly (Churchman, 1971). However, Internet agents are not executives. Agents represent a person, group, or organization, but are software programs that operate autonomously to accomplish unique tasks without direct human supervision (Minsky and Reicken, 1994). With the addition of uncertain reasoning, intelligent agents have the possibility of becoming intuitive (Kogan et al., 1998). Intelligent agents can generate evidence and learn from that evidence, hence meeting the requirements of a Singerian IS. However, these agents can potentially suffer from the Leibnizian problem of context handling. A Kantian solution for this is the inclusion of multiple logical processors within the agent intelligence. The possibility exists for some of these logical processors to be antithetical, thus incorporating Hegelian logic when searching cyber space.

An example of an intelligent agent that demonstrates the convergence of types of evidence is the FRAANK agent (Nelson et al. 1998). Figure 1 shows the FRAANK architecture and its philosophical foundations. This agent performs the more mundane and manual tasks of the accounting audit function, in effect the Lockean tasks. Artificial intelligence and uncertain reasoning within the agent develops models for determining conflicting or contradictory Hegelian information that predicts bankruptcies (Fanning and Cogger 1994) and the potential for management fraud (Fanning et al. 1995). By incorporating multiple logical processors, each with Leibnizian embedded logic, this agent tests for going concern judgments (Biggs et al. 1992), with timely information of the client and the industry. This industry data is a result of a Singerian Internet context search of competitors and news sources by the agent. The context issue is addressed by the continuous building of a context knowledge base using neural network technology.

Discussion: The boundary-less world of the Internet presents challenges for researchers attempting to address structured but outdated business problems, such as auditing, in new and "wicked" ways. The FRAANK architecture demonstrates that multiple philosophical perspectives can be incorporated to broaden the problem space of a traditional business function and potentially provide great value added to the organizations performing or transforming the function. The challenge is not to merely research problems from multiple philosophical perspectives, but to proactively embrace these perspectives to create new value in the boundary-less world.

References

Bhimani, Anish. 1996. Securing the Commercial Internet. *Communications of the ACM*, Volume 39, N. 6, June, pp. 29-35.

Biggs, S. F., M. Selfridge and G. R. Krupka. 1992. A Computational Model of Auditor Knowledge and Reasoning Process in the Going-Concern Judgment. *Auditing: A Journal of Practice and Theory*, Supplement, pp. 82-112.

Churchman, C. West. The Design of Inquiring Systems. Basic Books, New York 1971.

Courtney, James, Croasdell, David and Paradice, David, "Inquiring Organizations", *Australian Journal of Information Systems*, 1998 (forthcoming)
Davenport, Thomas; DeLong, David W.; Beers, Michael C. 1998. Successful Knowledge Management Projects. *Sloan Management Review*, Winter 1998, pp. 43-57.
Etzioni, Oren and Selberg, Erik. 1997. The MetaCrawler Architecture for Resource Aggregation on the Web. *IEEE Expert*. Vol 12, N 1, Jan/Feb 1997. Pp. 8-15.
Fanning, K. and K. Cogger. 1994. A Comparison Analysis of Artificial Neural Networks for Financial Distress. *International Journal of Intelligent Systems in Accounting & Management*, Vol 3, No. 4, December, pp. 241-252.
Fanning, K., K. Cogger and R. Srivastava. 1995. Detection of Management Fraud: A Neural Network Approach. *International Journal of Intelligent Systems in Accounting & Management*, Vol. 4, December, pp. 113-126.
Horwitt, Elisabeth. 1997. In Search of Good Searching. *Computerworld*. Vol 31, N 17, April 28,1997.
Kogan, Alex, Nelson, Kay M., Srivastava, Rajendra and Vasarhelyi, Miklos, "FRAANK: Financial Reporting and Auditing Agent with Net Knowledge", *Proceedings of The American Accounting Association*, May 1998
Madnick, Stuart E., "Are We Moving Toward an Information SuperHighway
or a Tower of Babel? The Challenge of Large-Scale Semantic Heterogeneity," *working paper*, Center for Information System Research, Sloan School of Management, Massachusetts Institute of Technology, 1997
Mason, Richard O. and Mitroff, Ian I. 1973. A Program for Research on Management Information Systems. *Management Science*, Vol 19, N 5, Jan 1973, pp. 475-487.
Minsky, Marvin and Riecken, Doug. 1994. A Conversation with Marvin Minsky About Agents, Communications of the ACM, Vol. 27, No. 7, July, pp. 22-29.

Nelson, Kay M., Kogan, Alex, Srivastava, Rajendra and Vasarhelyi, Miklos "Virtual Auditing Agents: The Edgar Agent Example," *Proceedings of the Hawaii International Conference on Systems Science*, January 1998

Figure 1
FRAANK Architecture